Description

The invention relates to a method for producing an electronic component and to an electronic component, particularly thin QFPs, wherein a standardized feeder cable frame and an integrated circuit are utilized and are embedded in a casting or molding material.

Surface-mounted electronic components, also known as SMD components, are typically embedded in a housing which is made of a plastic molding compound, with the electronic terminals leading out of the housing. These housings correspond to a standard with fixed dimensions depending on how many terminals are needed, so that a standardized production and automatic mounting of PCBs is possible. The dimensions of these housings are defined in German and international standards. The lead frames that are used for achieving a precisely positioned embedding of the electrical terminals are likewise standardized. Provided at the center of these lead frames are islands onto which the integrated circuits are fastened. The lead frame and integrated circuit are then molded together from molding material in the housing. Tensions arise owing to the different coefficients of expansion of the iron/nickel alloy that is usually used for the lead frame, the silicon chip that forms the integrated circuit, and the molding material of the housing, and furthermore the shrinkage of the molding material. This causes diagonal swells of up to 100 μm, particularly in large flat housings (thin QFPs, i.e. TQFPs).

In order to prevent this housing deformation or bulging, also referred to as warpage, special island designs are used. Holes or slits are made in the islands, which are disposed centrally in the lead frames, or the islands are underetched, or grooves are etched into them. Copper lead frames have also been tried in order to minimize the housing deformation. But all these solutions require new or modified assembly processes, or they can be carried out only with etched lead frames and not punched lead frames, or they lead to a reduction of the rigidity of the external terminals.

It is thus the object of the invention to propose a method and an electronic component of the above described type which minimize the housing deformation by constructionally simple means.

The object is achieved with respect to the method by the features of claim 1 and with respect to the device by the characterizing features of claim 5. Advantageous developments are described in the subclaims.

According to the basic idea of the invention, in the method for producing an electronic component, a standardized lead frame is used which has a defined number of leads and a central island for accommodating an integrated circuit, each lead frame being suitable for a set of integrated circuits of different sizes. The island is then reduced to a size that substantially corresponds to the size of the respective integrated circuit that is utilized. Next, the lead frame with the integrated circuit fixed thereon are embedded in a casting or molding material and centered such that there is the same amount of molding material above the circuit and below the island, respectively. This most effectively prevents the island from projecting beyond the base surface of the integrated circuit, which would cause asymmetry in the distribution of molding material. With this configuration, the shrinking of the molding material at the perimeter of the integrated circuit does not produce tensions between the edge of the circuit and the edge of the island, which lead to deformation of the housing.

The lead frame, with the island constructed as one piece therewith, is preferably punched in order to give the island the desired size. Alternatively, the lead frame and island can be processed by means of etching processes.

The fitting of the islands preferably takes place after the standard lead frame has been produced, because then only one complete standardized lead frame must be utilized. On the other hand, the fitting of the islands can also be integrated into the lead frame fabrication process, though this requires that a variety of fitted lead frames be produced with island dimensions that are adapted to the respective dimensions of the integrated circuit. The tools for producing the lead frames are modular, so that an adjustment of the island size is easy to carry out.

Typically, the island is reduced to a size that is somewhat larger than that of the integrated circuit. The integrated circuit is preferably fastened to the island by gluing with a silver conductive glue. The glue, which protrudes between the integrated circuit and the island, is checked and serves as a measure of correct fastening. A fillet then

forms in the region of the protruding portion of the island, which can be effectively inspected optically.

With the inventive method, an electronic component is produced with an integrated circuit and a standardized housing consisting of casting or molding material into which the integrated circuit is embedded and with a lead frame comprising a central island for accommodating the integrated circuit. This electronic component is characterized in that the island terminates substantially flush with the integrated circuit, and that the space between the top surface of the housing and the integrated circuit corresponds to the space between the bottom surface of the housing and the island. If the island is larger than the integrated circuit that is fastened on it, then, in the region of the protruding end of the island, the molding material between the top surface of the island and the top surface of the housing has a different thickness than the molding material between the bottom surface of the island and the bottom surface of the housing. This difference in thickness, in conjunction with the rigid lead frame that is made of a special metal alloy, cause tensions in the housing that manifest themselves in deformation of the housing.

Assuming that materials, production equipment, processes and process parameters are identical, the degree of housing deformation is determined solely by the ratio of the surface area of the base of the integrated circuit to the surface area of the island. By adapting the size of the island to the respective base surface of the integrated circuit, the tensions between the integrated circuit, the lead frame, and the molding material are so balanced, that the housing deformation is reduced or eliminated according to the ratio of the surface areas to one another.

In order to achieve particularly good minimization of the housing deformation, the island is constructed flush with the integrated circuit that is fastened on it. The island and the integrated circuit are then exactly the same size. As a result, the molding material between the top surface of the integrated circuit and the top edge of the housing has the same thickness as the molding material between the bottom surface of the island and the bottom edge of the housing at all points in the housing, and the tensions compensate one another. The bimetal effect that occurs based on the different coefficients of expansion is prevented by the symmetrical structure.

In another development of the invention, it can be advantageous when the island is constructed somewhat larger than the integrated circuit, whereby the integrated circuit is glued onto the island, and the excess glue on the protruding portion of the island forms a fillet whose formation provides a means by which it is possible to check whether the integrated circuit is glued onto the island correctly. It is particularly advantageous to construct the island such that the ratio of the surface area of the base of the integrated circuit to the surface area of the island equals 0.9:1.

According to the invention, the island is constructed as a contiguous unstructured surface. This guarantees that the molding material above and below the integrated circuit and the island is of equal thickness. Furthermore, the structuring steps and special designs for the island that are provided in the prior art are eliminated.

In another embodiment of the invention, the leads can be led as far as the island. This is expedient particularly for very small integrated circuits, in which there would otherwise be an overly large space from the leads to the island, which could cause problems in subsequent contacting.

Various exemplifying embodiments of the invention will now be described in connection with a drawing. Shown in schematic representation are:

Fig. 1: a lateral sectional view of an inventive component with a large integrated circuit;

Fig. 2: a lateral sectional view through an inventive component with a small integrated circuit; and

Fig. 3: a lateral sectional view through an inventive component with a small integrated circuit and an island that is flush therewith.

Fig. 1 represents a cross-section through an electronic component in which a lead frame 2 is utilized, which consists specifically of the leads 3 and an island 4. An integrated circuit 1 is fastened onto the island 4, and the lead frame 2 and the integrated circuit 1 are then embedded in a housing 6 consisting of molding material. During that process, the circuit 1 and the island 4 are disposed at such heights, that there emerge housing regions 7 and 8 with equal thicknesses a and b, respectively. The size of the island 4 has been inventively fitted to the base surface of the integrated circuit 1, so that these substantially correspond. The island 4 is larger then the base surface of the

integrated circuit 1 merely by a small projecting portion, so that the glue that is used for fastening the integrated circuit 1 on the island 4 can escape, forming a fillet 5 on the projecting portion. This fillet 5 constitutes a suitable control parameter for monitoring an optimal bonding of the integrated circuit 1 with the island 4. The overall lead frame 2 is disposed at such a height, that the leads 3 are likewise centered in the housing 6. Housing regions with an equal thickness, referenced c in the Figure, thus extend above and below the leads. The island 4 is thus inventively sunk relative to the leads 3, namely in a manner that is adapted to the height of the integrated circuit 1. This adaptation according to height is taken into consideration in the production of the lead frame 2 and the bonds between the leads 3 and the island 4.

Fig. 2 represents an inventive electronic component with a small integrated circuit 11. To that end, the island 14 is fitted to the smaller integrated circuit 11 and constructed smaller, accordingly. The ratio of the area of the base of the integrated circuit 11 to the area of the island 14 equals 0.9:1. The island 14 is so sunk relative to the leads 3 within the lead frame 2, that housing regions with an equal thickness c emerge above and below the leads 3, and housing regions 7 with the thickness a and housing regions 8 with the thickness b, where a=b, emerge above and below the integrated circuit 11 and the island 14. In this exemplifying embodiment also, a small excess portion of the island 14, at which tensions emerge as a result of the molding material shrinkage, is accepted as a trade-off for the ability to generate a fillet 5 on this excess island portion, said fillet being an important control parameter in the production process.

Fig. 3 represents another embodiment of the invention comprising a small integrated circuit 11 and an island 24 that terminates flush therewith. In this example, there are no protruding island regions at which tensions could arise as a consequence of the molding material shrinkage.

The Figures only represent integrated circuits 1 and 11 with two different sizes. Of course, a whole set of integrated circuits with different sizes is utilized for a standardized housing 6. The size of the island is adapted to the size of the base surface of the integrated circuit, so that the standard lead frame is inventively further processed and can be utilized for an entire set of different integrated circuits, without housing

deformations occurring. The above described housings are large, thin, square housings, what are known as TQFPs, with 176 leads, for example, which are led from the square housing on all four sides.